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Certificate

I, ELIZABETH FLINT, residing at 2, CLEVELAND PLACE, EXMOUTH, DEVON, ENGLAND EX8 1BL

hereby declare

that I am familiar with the German and English languages and I am a professional translator.

That I have prepared a translation of Application PCT/EP2005/009260, filed August 27, 2005 and entitled „Gassack und Kraftfahrzeug" (Air bag and motor vehicle), said translation thereof being attached thereto and made part of this declaration.

To the best of my knowledge and belief, the above-mentioned translation is accurate and fairly reflects the contents and meaning of the original document.

I declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct.

Executed on 5. 01. 2006 (5. January 2006)

Elizabeth Flint

(Name of Translator)

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Airbag and motor vehicle

Description

Technical background of the invention

The invention relates to an airbag according to the introductory section of Claim 1, a motor vehicle according to the introductory section of Claim 8 and a motor vehicle according to the introductory section of Claim 9.

State of the art

Airbags which do not have any mechanisms for situation-dependent regulation of the internal pressure can only be ideal for a vehicle occupant of a certain weight and a certain height in specific accident situations. In different accidents from those specified, the airbag is either too hard or too soft. If, for example, such an unregulated airbag is designed for a male wearing a set belt who is 1.80 m tall and who weighs 80 kg, it is too hard for a female wearing a set belt who is 1.65 m tall and weighs 60 kg, while it would be too soft for the male described above if he were not wearing a seat belt.

In order to counteract this problem, airbags with at least one venting arrangement, via which the gas can exit from the airbag are known, whereby the gas stream can be throttled by this venting arrangement depending on the situation. In addition, active systems exist where, for example, sensors measure the weight of the occupants and starting from this measuring result the effective cross-section of the venting arrangement is adjusted electrically. Such systems are complex and correspondingly expensive and liable to operational faults and disturbances.

An airbag with variable internal pressure is known from EP 1 044 855 B1 whose internal pressure depends on the size of the vehicle occupant to be retained, and whose venting arrangement which is responsible for this task functions passively. The airbag described here is designed with two casings, with an inner and outer airbag cover. The inner casing exhibits holes or permeable fabric in a certain area, so that here gas can penetrate from the gas chamber which is surrounded by the inner airbag cover into the area between the inner airbag cover and the outer airbag cover and from there can fully exit from the airbag. If a vehicle occupant now strikes against the outer airbag cover, this cover is now pressed in sections onto the inner airbag cover, so that a part of the holes or the permeable fabric is covered and the gas stream reduced. The larger the occupant who strikes the airbag, the more the airstream is throttled and therefore the harder the airbag.

Because of this two-casing design, the airbag becomes relatively heavy and requires a relatively large volume of space when folded. Furthermore, such an airbag becomes strongly cushion-shaped during filling, so that it is difficult to implement a side airbag of this design.

Object of the invention

Starting from this point, it is the task of the invention to further develop an airbag of the generic type described in such a way that it is smaller and lighter in its quiescent state and that it can also be designed as a side airbag. A further task of the invention is to create a vehicle with such an airbag.

These tasks are solved by means of an airbag with the characteristics of Claim 1 and by motor vehicles with the characteristics of Claim 8 or 9.

The airbag which is used also exhibits a venting arrangement which is formed in such a way that when a certain area of the airbag cover strikes an

obstacle, in this case a vehicle occupant, the gas stream which exits from the airbag can be throttled or completely blocked.

According to the invention, the venting arrangement consists of at least one opening in the airbag cover and a tube joined to the cover which is connected with the airbag cover. The opening can be a hole in the airbag cover, or a gas-permeable fabric section. The necessary tube is in particular in the embodiment described in Claim 4 very easy to manufacture and only slightly increases the weight and the packing volume of the airbag. The form of the impact surface is not basically influenced by the tube, so that an airbag according to the invention can also be designed for use as a side airbag.

The surface of such a tube is relatively small. However, in order to achieve the desired effect despite this, namely that the hardness of the airbag adapts to the size of the vehicle occupant and the accident situation, the tube must be located at a thoughtfully selected area of the expanded airbag. In the case of a side airbag, the tube preferably extends basically horizontal at the height of the shoulders of a 50 percentile male in his standard seating positions.

In the case of a front airbag, the tube preferably extends from a lower central area to the outside, and/or it extends basically horizontally in a mid to top area. It is also possible to provide several tubes running parallel to one another.

Further preferred embodiments result from the further subclaims as well as from the embodiments described below with reference to the Figures. The embodiments also describe the precise functioning of the invention in more detail.

The Figures are as follows:

Short description of the drawings

Figure 1	A completely expanded side airbag with a venting arrangement according to the invention,
Figure 2	The section along Line A-A from Figure 1,
Figure 3	The installed side airbag from Figure 1 with the dummy of a small person,
Figure 4	The installed side airbag from Figure 1 with a dummy of a 50 percentile male in standard seating position,
Figure 5	The items shown in Figure 4, whereby the upper body of the dummy is rotated to the front,
Figure 6	A fully-expanded front airbag with a venting arrangement according to the invention,
Figure 7	The section along Line B-B from Figure 6,
Figure 8	The front airbag from Figure 6 with dummies of different sizes wearing seat belts, whose head and breast areas are lying on the airbag,
Figure 9 ing	The items shown in Figure 8 in the case of dummies not wear- seat belts,
Figure 10	The airbag from Figures 8 and 9 with a 50 percentile dummy not wearing a seat belt in the case of a 30° offset frontal collision,
Figure 11	A second embodiment of a front airbag according to the invention with dummies of different sizes wearing seat belts ,
Figure 12	The items shown in Figure 11 with dummies not wearing seat belts,
Figure 13	The front airbag from Figures 11 and 12 with a 50 percentile dummy in a diagonal impact offset by 30°,
Figure 14	A variation of the front airbag shown in Figures 6 to 10 and
Figure 15	A variation of the front airbag shown in Figures 11 to 13,
Figure 16	A schematic representation of a further embodiment of a front airbag in active condition,
Figure 17	A bird's eye view of the airbag from Figure 16,

Figure 18 A section of the airbag from Figure 16 in an enlarged sectional view,

Figure 19 A cross-section through the tube of the airbag from Figure 18,

Figure 20 A schematic representation corresponding to that of Figure 16 during impact of a vehicle occupant or dummy onto the airbag,

Figure 21 A representation corresponding to that of Figure 19, during impact of a vehicle occupant or dummy, showing the change in cross-section of the tube,

Figure 22 A section of an airbag according to a further embodiment,

Figure 23 A schematic representation of a further embodiment of a front airbag formed as a passenger airbag with a dummy representing a female and

Figure 24 The items shown in Figure 23 with a dummy representing a male.

Description of preferred embodiments

The innovation according to the invention can be used in side airbags and in front airbags. In a first embodiment to be described first, the airbag is a side airbag.

a) Side airbag

Figure 1 shows an airbag 10 in the form of a side airbag. In an upper area the impact surface 12 of airbag 10 exhibits an opening 14. From this opening 14, the tube 16 extends in a slightly bent form, however, mainly horizontally. Tube 16 is formed from a fabric element 18 which is sewn onto the outer cover of the airbag, and by the airbag cover 19 itself (see also Figure 2). Opening 14 can be a hole in the airbag cover or a gas-permeable area of the airbag cover. A front side of the tube is open, so that an exit opening is formed.

In expanded, but non-loaded state, gas flows from the interior of airbag 10 through opening 14 into tube 16 and from there into the interior of the motor vehicle, therefore to the outside from the point of view of the airbag. The same thing happens if the impact surface 12 is pressed in an area beneath tube 16. However, if one presses onto tube 16 from the outside, the tube is fully or partly closed, so that no or less gas can escape from this venting arrangement, and the airbag becomes harder.

Figures 3 to 5 show how tube 16 has to be positioned in the vehicle with a fully expanded airbag 10. In this connection, Figure 3 shows a dummy D1 of a 5 percentile female in her standard seating position. Tube 16 is at the height of the neck. If in case of a side impact, dummy D1 or a vehicle occupant strikes against airbag 10, it is almost exclusively the shoulder area which comes into contact with the impact surface. This means that in this case tube 16 is not loaded, so that gas can escape through this venting arrangement and the airbag becomes relatively soft.

Figures 4 and 5 show the situation in the case of a 50 percentile male. In the case of a second dummy D2 representing this occupant, the shoulder area is at the height of tube 16. If the occupant strikes against airbag 10, the gas flow through tube 16 is blocked, no gas can escape and the airbag becomes correspondingly harder. In general, at least a further venting opening is provided, so that the airbag maintains a certain yielding quality also in this case.

As can be seen from Figure 5, tube 16 is also blocked when the upper body of the occupant has previously rotated in the longitudinal direction of the vehicle because of a deceleration motion.

b) Front airbag

As already mentioned, the concept according to the invention can also be used for front airbags. Figure 6 shows a first embodiment of such an airbag

10 designed as a front airbag. As is also the case in the embodiment mentioned above, impact surface 12 carries the venting arrangement consisting of an opening 14 and a tube. Reference can be made to the above with regard to the mode of functioning and the form of tube 16.

Figures 8 to 10 show the position of the front airbag shown in Figure 6 in relation to a dummy which has fallen into airbag 10 in different accident situations. Figure 8 shows the situation in case of a frontal collision with a vehicle occupant wearing a seat belt. The first dummy D1 shows a 5 percentile female and the second dummy D2 shows a 50 percentile occupant and the third dummy D3 a 95 percentile male.

As can be seen, only the 95 percentile male closes the venting arrangement and makes the airbag correspondingly hard. The venting arrangement remains open with the other two types of occupant.

Figure 9 shows the situation with the same types of vehicle occupants, but when they are not wearing seat belts. Because of the greater forward displacement of the pelvis, there is an upright upper body angle and therefore a higher position of the breast area and the head. It is possible to recognise here that the 95 percentile male and the 50 percentile occupant close the venting arrangement if they are not wearing seat belts and that the arrangement only remains open in the case of the 5 percentile female. Therefore it is possible to see that the internal pressure of the airbag not only adapts to the size of the vehicle occupants, and therefore also generally speaking to their weight, but it also adapts to the accident situation – here with belt/without belt.

Tube 16 is arranged basically horizontally in a slight curve on impact surface 12. The curved shape is selected so that the behaviour of the system is still maintained if the upper body of the vehicle occupant is tilted when it falls into the bag because of a front impact offset to the side. This is shown in Figure

10, which shows a 50 percentile occupant not wearing a belt (second dummy D2) in the case of a frontal collision offset by 30°.

In the embodiments shown up to now, there are basically only two states, namely "venting arrangement open" and "venting arrangement closed". In some applications it can naturally be desirable to achieve a kind of continuous regulation of the airbag hardness.

Figures 11 to 13 show an embodiment of a front airbag which fulfils this requirement. In this embodiment, the venting arrangement exhibits two tubes in which several openings of the airbag cover end respectively. The two tubes 16 respectively extend from a lower central area diagonally upwards. Because of this arrangement, the number of covered openings 14 in a frontal collision depends on the size of the occupant and on the situation as to whether the occupant is wearing a seat belt or not.

Figure 11 shows the situation with dummies D1-D3 of different sizes, which correspond to the dummies in Figures 8 to 10. It can be seen that the smallest dummy D1 covers four openings, the largest dummy D3 six openings and the central dummy D2 five openings. The airbag therefore becomes harder as the occupants to be retained become larger.

Figure 12 shows the situation from Figure 11 with an occupant not wearing a seat belt. Here it can be seen that the respective same occupant covers more openings, so that the airbag becomes correspondingly harder.

Figure 13 shows the situation in a 30° diagonal impact and a 50 percentile dummy D2 not wearing a seat belt. Because of the symmetrical structure of the tubes 16 running upwards at a slope, the number of openings 14 which are covered are the same as in the frontal collision shown in Figure 12. This means that the behaviour of the airbag is non-variant in relation to the angle of collision impact at least within a certain range.

The hardness of the embodiments of a front airbag described up to now does not depend on whether a pure frontal collision or a frontal collision which is offset to the side occurs. This is often useful and desirable. In some vehicle types, however, it can be desired that the front airbag behaves differently in the case of a frontal collision offset to the side than in a pure frontal collision and particularly that the airbag exhibits greater holding capacity as regards the occupant in the case of a frontal collision offset to the side.

The embodiments shown in Figures 14 and 15 fulfil this requirement:

Figure 14 shows a variation of the airbag shown and described in Figures 6 to 10. Within this, Figure 14 corresponds to the situation shown in Figure 10. In addition to the first opening 14, the airbag cover exhibits a further opening 14b, which opens into tube 16. In the case of a diagonally offset collision, as shown in Figure 14, both openings 14,14b are blocked and the airbag reaches its maximum hardness. In the case of the pure frontal collision, see again, for example, Figures 8 and 9, only the gas stream from the first opening 14 is blocked, while the second opening 14b remains free and the airbag has a lesser hardness.

Figure 15 shows a variation of the front airbag described in Figures 11 to 13. Here, there is only one tube 16, in which several holes 14 end. In the case of a diagonal impact, more holes 14 are covered, and there is no compensation for this by means of a symmetrically arranged further tube 16, so that the airbag can form a greater internal pressure here too in the case of a diagonally offset front impact.

Tubes 16 are led to the edge of the airbag in all embodiments, so that the occupant cannot come into contact with hot gases being expelled from the airbag.

The embodiment shown in Figures 16 to 21 exhibits several tubes 16 which are arranged in parallel on the impact surface 12 of an airbag 10 serving as a passenger airbag, which serve as venting channels. Figure 16 shows the activated state, in which the airbag 10 is filled with gas. The further components required to activate the airbag unit are not shown in the figures for the sake of simplicity. Figure 16 shows dummy D2 which is about to move towards airbag 10 which is filled with gas.

The arrangement of the tubes of airbag 10 can be seen in the birds-eye view of Airbag 10 in Figure 17. One opening 14 opens into tubes (venting channels) 16, 16', 16" respectively. When airbag 10 is inflated by being filled with gas, gas flows out of openings 16 causing tubes 16, 16', 16" to be inflated. In the embodiment shown here, openings 14 open into the tube at a distance to the two open ends of tubes 16, 16', 16" approximately in the centre between the two ends.

Tubes 16, 16', 16" are each formed by a fabric element 18 connected with the cover of airbag 10, as shown in schematic form in Figure 19. Fabric element 18 consists of the same material as airbag 10. This means that each fabric element 18 is flexible and in this embodiment takes on approximately the cross-sectional form shown in Figure 19. The cross-section through the tube 16 shown in Figure 19 is represented in the area of the opening 14 which opens into tube 16. The fabric elements 18 of the individual tubes 16 raise themselves from impact surface 12 of airbag 10 facing towards dummy D2 because of the pressure existing in airbag 10 and exiting through openings 14 into the individual tubes 16, 16', 16". Depending on the kinetic energy with which dummy D2 strikes the impact surface 12 of airbag 10 with tubes 16, 16', 16", these are more or less deformed with regard to their cross-sectional surface, as shown in schematic form in Figures 20 and 21. The flexible and yielding characteristics of fabric elements 18 of individual tubes 16, 16', 16" are utilised here. If dummy D2 strikes tubes 16, 16', 16" of airbag 10 with higher kinetic energy, the free cross-sectional surface available for

venting of airbag 10 in the area of the impact is correspondingly more strongly deformed and therefore its free capacity as regards gas throughflow is reduced, so that the gas contained in airbag 10 can only escape more slowly. Airbag 10 is then harder compared with the case that dummy D2 meets the activated airbag with lower kinetic energy. In such a case, the free cross-sectional surface of tubes 16, 16', 16" is only reduced to a lesser extent (if at all); airbag 10 is therefore softer, as the gas contained in it can flow out through the larger cross-sectional flow area which remains free.

Figure 22 shows a section of a further airbag 10 which exhibits a large number of openings 14, which each open into a short tube 16. In this embodiment, tubes 16 serve the same purpose as the tubes in the embodiment described in Figures 16 to 21. The intention of the embodiment shown in Figure 22 is to demonstrate that tubes can in principle also be extremely short.

Figures 23 and 24 show a further embodiment of a front airbag which serves as a passenger airbag. Here, tube 16, in which the openings 14 (not shown) end, is located in an area which, when the airbag is fully expanded, is in an area in front of the instrument panel I. Tube 16 extends basically horizontal and vertical to the longitudinal axis of the vehicle.

Figure 23 shows the situation with a first dummy of a 5 percentile women. Here, the upper body of dummy D1 is already displaced forwards following the collision. It can be seen that the knee area of the dummy D1 does not touch tube 16, so that airbag 10 is vented by tube 16. The airbag is therefore relatively soft.

Figure 24 shows the situation with a dummy D3 which represents a 95 percentile male. Because of the clearly longer length of the legs compared with dummy D1, after a certain forwards displacement, an area above the knee of dummy D3 pressed on tube 16, thus closing it. Airbag 10 is not or only

slightly vented through tube 16, so that the desired increase in internal pressure and therefore hardness of the airbag occurs.

The location of tube 15 in the area shown here in front of instrument panel I and the spatial relationship of tube 16 to the knees or an area shortly above the knees of the occupant has the advantage that adaptation of the internal pressure already takes place completely or in part before the upper body meets impact surface 12. In addition, because of the different leg lengths, small and large vehicle occupants can be differentiated with a high degree of reliability.

As a rule a further venting opening is present in all embodiments relating to a front airbag, so that a certain softness is also present if the tube or tubes 16 are completely blocked.

List of reference numbers

10	Airbag
12	Impact surface
14	Opening
16	Tube
18	Fabric element
19	Airbag cover
D1	First dummy - dummy of a 5 percentile female
D2	Second dummy - dummy of a 50 percentile occupant
D3	Third dummy - dummy of a 95 percentile male
I	Instrument panel